DOCUMENT RESUME

ED 104 733 SO 008 128

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TITLE The Use of Inter-Nation Simulation as a Research Tool.
PUB DATE 71
NOTE 44p.; Paper presented at the Annual Meeting of the Canadian Political Science Association (St. Johns, Newfoundland, June 1971)

EDRS PRICE MF-$0.76 HC-$1.95 PLUS POSTAGE
DESCRIPTORS *Foreign Relations; International Education; Learning Activities; Models; Political Science; *Research; Research Methodology; *Research Tools; *Simulation; Social Sciences; *Teaching Techniques

ABSTRACT

After four years of using simulation in the study of international relations, the authors have found it to be a potentially powerful research and teaching device. In this report they examine advantages, such as the ability it gives the researcher to manipulate experimental variables, and disadvantages associated specifically with the use of simulation in political science. They contend that the use of simulation is often prematurely rejected when refinement on the basis of legitimate criticism is what is needed. Among the research strategies available for testing and revising simulation models is face validity evaluation which the authors use in their revision of the Inter-National Simulation (INS) to exemplify such refinement. In INS greater realism and sophistication results when a military advisor is included in the national decision making organization, when geographic dimensions and historical background are increased, and when internal revolution is introduced. A number of practical considerations associated with simulation in conducting a research project are also included in the paper--all in the hope of promoting the use of simulation as a research technique in political science. (JR)

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THE USE OF INTER-NATION SIMULATION AS A RESEARCH TOOL

by

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A paper prepared for the 1971 Annual Meeting
of the Canadian Political Science Association
St. Johns, Newfoundland, June 8 - 11, 1971.

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Introduction

This paper is motivated by our concern that simulation is an under-rated and under-used technique in the study of international relations. After employing the method at the University of Alberta over the past four years, the authors are convinced that simulation has powerful potential as a research device as well as offering outstanding advantages in the teaching of international relations. It is our opinion that this potential has not been fully realized by our colleagues. Some political scientists, we believe, may simply be unapprised of the technique's merit; others may have been "intimidated" by criticisms levelled at simulation; still others may be uncertain as to how to proceed with a simulation exercise. Our purpose, very openly, is to proselytize.

We will set out the advantages gained in using simulation. Next we will treat major criticisms of the technique with the aim of encouraging further research. Effective debate about the utility of simulation has been lost in a flood of rhetoric. We argue that only by experimentation through use can we again focus on the real potential of this technique. We will then relate some innovations in simulation

that we have attempted as examples of initial developments toward a comprehensive research tool. Finally we shall propose a research strategy utilizing the simulation technique. Our examples will be drawn from three research projects conducted at the University of Alberta. We hope this format will stimulate other political scientists suffering from any of the inhibitions mentioned above to re-assess their position vis a vis what we consider to be an important new research and teaching device. Overall we hope to contribute to the increased use of simulation in Canadian schools.

II

The Advantages of Simulation

Simulation is ". . . the application to international relations of essentially experimental techniques."[1] "Access, control, and replication are three words that signify the merits of a laboratory technique like simulation."[2] Thus the simulator attempts to overcome certain research problems in international relations . . . unrecorded or classified data, inability to manipulate variables, infrequent events of the same nature . . . that are faced when analyzing events in the real world. Such an experimental technique also offers the advantage of studying questions which have "no apparent

counterparts in prior experience."[3] It also allows the investigator to analyze problems with a lesser investment in terms of time, money and energy.

Beyond these basic merits of simulation as an experimental technique there are a number of advantages that it offers.

1. Organizing and consistency-checking method - the very expression of a simulation model requires precise definition of variables and relationships. Vague or intuitive assumptions soon become glaringly apparent.[4]

2. Theory building - The ability to manipulate variables and relationships promotes the simulator's ability to assess their significance and importance. His model "grows" as he experiments to account for more real world phenomena.[5]

3. Theory comparing - A simulation exercise can be made to generate the consequences of an espoused theory of international relations. Thus the outputs of two or more such theories can be compared and assessed.

4. Briefing - Simulation provides a useful vehicle for the presentation of a "total picture" in a relatively short time. Simulators see a complex system in operation and can extract a number of simultaneous observations.[6]

5. Hypothesis testing - Specific "if . . . then" propositions can be treated through the technique. Simulators can create the controlled "if" conditions to see whether their predictions follow rather than searching or waiting for such conditions in the real world.

6. Policy planning - Simulations can be used to generate the probability distribution of outcomes associated with different strategies.[7]

7. Generalists from specialists - An often overlooked but extremely important demand that simulation makes on a researcher is the requirement to draw back from specialized interests and view systems in a wider perspective. While this pressure, in itself, will not guarantee superior research, it increases the probability that the researcher will not reach conclusions based on too narrow a focus.[8]

One outstanding attribute of simulation requires mention. The teaching function is distinct from the role of research technique, nevertheless this function may well be the one that returns the greatest dividends. Simulation exercises offer the following advantages to participants:[9]

1. Immediate testing of classroom knowledge - In games of free play the student gains the opportunity to try out the conclusions he reached listening to lectures and participating in discussion sections.

2. Encouragement to learn at one's own pace - Students contribute according to their own capabilities and realize a sense of accomplishment based on their own measurement (rather than on fixed classroom standards such as examinations and assignments).

3. Elimination of contradictory role of instructor as teacher and judge - By interaction with others in a game the student and his peers become judges of performance.

4. Inspiration to more sophisticated inquiry - Simulations demonstrate that learning can be "fun". Often questions of interest or insights are gained during exercises which encourage students to follow-up.

5. Development of special skills - Students learn such skills as communication and bargaining; often they gain confidence in their abilities to relate to others or handle life situations.

6. Understanding complex relationships - Simulation offers a complex but manageable system of relationships. Students experience the far reaching effects of a single "simple" solution. They realize the interrelatedness of variables.

7. Training - The acquisition of a skill requires practise. Possible future policy makers can develop talents under conditions which do not have immediate and possibly harmful consequences for the real world. The student gains familiarity with handling pressure and crisis situations.

III

The Limitations of Simulation

Application of the laboratory technique to the study of international relations has not been carried out without difficulty and severe criticism. Our opinion is that much of the debate surrounding the legitimacy of simulation as a research tool misses the mark. We feel that such debate reduces ad absurdam to little more than claim and counter-claim about the operations of the referent system. These claims are amenable to empirical investigation, most of which has not yet been carried out. To reach conclusions about the validity of simulation before such research is done is unscholarly and premature. We will illustrate the type of questions that require more inquiry but before doing so a few preliminary remarks are in order to put the whole discussion in perspective.

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First, simulation is a proven technique. It has been successfully applied in a number of fields where its legitimacy is not seriously questioned.[10] Let us be clear that simulation qua technique is not under debate. The argument is whether a proven technique is valuable or useful in our particular field that of international relations.

It bears repeating that simulation models are simplifications not intended to replicate every aspect of the referent system; only those which are considered to be key variables. Some variables are always left out or modified. The simulator strives to capture the significant variables that will allow him to explain and predict while retaining a manageable model. Omission of influencing factors will incur some penalties in simulator's research but these may be acceptable if he can isolate the major variables bearing on the problem at hand. Equally worthwhile, the researcher finds that simulation in the majority of cases is self correcting in that key variables if left out of his model become glaringly obvious when the latter is operationalized. In short, the simulator is attempting to sort out the essential from the peripheral. The device he uses helps him to do so.

This understanding leads to the third observation. The attempt to apply simulation to our discipline is relatively

recent. It is unreasonable to expect that initial formulations of simulation models will immediately capture the central features of a referent system. At the very core of simulating is the idea of improvement of a model through testing and revision. The literature produced by simulators abounds with remarks belabouring the tentative, heuristic nature of simulation endeavor.[11] These reflect less the normal cautionary posturing of social scientists than the understanding that simulation is in its infancy. The simulator is less eager to defend his model than to critically examine and modify it.

To this purpose the criticisms of simulation have been useful. They help focus on many important questions that must be answered if our discipline is to advance. But we argue that this is all the criticisms do - raise questions. They do not constitute evidence one way or the other from which to judge the legitimacy of simulation. It is appropriate at this point to turn to such criticisms to illustrate the type of research we feel is still necessary.

It has been argued that participants in simulation exercises are drawn from one culture and are therfore bound to its values. This criticism is based upon the assumption that different cultures produce unique decision-making processes.

The most effective examples cited to buttress this argument fall into what we call the "East is east, West is west, etc " category. As Orientalists have not reached any definitive conclusions in regard to the effect of culture on decision-making, policy planning, state action and so forth, we do not propose to dissipate our research efforts by becoming involved in what we consider to be a peripheral academic exercise. We grant that once we can measure the varying effects of the cultural dimension we will be more effective not only as simulators but social scientists. The uniqueness of culture as well as the degree to which one will find common strains running between cultures for the present remains an open question. This is not meant to be an academic "cop-out" on our part. Simulation provides a useful way of focusing on this problem. Exercises with the same parameters have been run with participants of different cultural backgrounds. Where outputs differed, the researcher had a controlled means of isolating and identifying "cultural influences" on decision-making. Preliminary evidence suggests that cultural differences have been overstressed.[12]

Paralleling arguments surrounding cultural variables are those which tell us that commitments to particular ideologies produce different decision-making patterns. Again

the question is precisely what differences? A research strategy of comparing decisional outputs among participants of different ideological beliefs will throw more light on the problem. While we can regret that more comprehensive research has not been done in this area, we feel that the problems raised by the ideological variable can not rightly be seen as resulting from a flaw in the simulation technique. On the contrary we can use it to investigate the effect of the variable.[13]

A third criticism focuses on the lack of professional status of simulation participants. Real decision-makers achieve their roles through competition after some demonstration of competence in decision-making. Students and military cadets, most often used as participants, have no professional policy making qualifications. The extent to which this can jeopardize simulation results can only be ascertained after comparing student/cadet behavior with the actions of trained diplomats who participate in exercises. If these differences prove too great, it may well be that reliable research cannot be carried out with students or cadets. Here again we see that the device is not at fault. The answer to this criticism lies in the proper strategy in utilizing simulation.

The idiosyncratic factor in decision-making has been

a constant focus of criticism. Clearly many real world events have been significantly effected by the personalities of leaders. The interplay between idiosyncratic and situational variables is still under debate. Simulation research may provide two contributions. In the first place the capacity to repeat runs utilizing different participants allows us to control for personality. Broad patterns of interaction can be identified which have not been greatly affected by personality differences. An example of this would be to note factors contributing to alliance cohesion (or disintegration) regardless of the personalities acting as key decision-makers for different nations. Accessibility of data gained from repeated runs allows for the measuring of the impact of personality on international behavior. Paricipants in simulations can be pre-tested as to personality and attitude. The researcher has the capacity to place different persons in the same role observing variations in outputs (and correlating these to variations in personality and attitude profiles).

Still another complaint is that serious study of the causes and motives of going to war cannot be carried out in the absence of the real pain, suffering and death that occurs in actual wars.[14] Such pain acts as a constraint on real world

decision-makers but certainly not as an ultimate constraint since nations do go to war. Since the simulator is precluded from introducing actual pain and death in his model he must find restraints of sufficient strength to produce, reliable research results. To some extent he can depend on the natural psychological abhorence of death (be it even "paper killings") that is found in many participants. To strengthen this he may add penalties for going to war (such as requiring participants to deposit money on their nations which would be lost if that nation were destroyed in war). At each stage as obstacles to war are introduced the results are compared with real world behavior. As a digression we suspect that critics who make the argument that death and damage is missing from simulations react to their own images of participants who feel no responsibility firing simulated missiles at paper populations. From our own experiences we have observed this is not the case. In one series of 14 runs in which conditions went to the extreme - the researchers allowed one nation to become invulnerable to nuclear attack, i.e., they could use force with impunity - the expected irresponsible behavior did not materialize. To be sure there were two wars involving nuclear weapons but both were of the nature of the feared "accidental" war (the setting off of automatic response

defense systems). The restraints used were extra penalties against simulated commodities, i.e., loss of paper resources and prestige ratings, yet these appeared to be enough to inhibit the use of war as a prime instrument of foreign policy. For the present the worst aspects of lack of accountability in international simulation seem to be under control.

Another telling charge made against simulation is that events in the real world are affected by memory of earlier conditions; participants in simulation exercises have no "sense of history" motivating their behavior. To a large extent this problem is handled by writing histories of the "world" up to the point participants begin activities. Moreover penalties such as loss of office or lowering of domestic satisfaction can be attached to radical departures in behavior from the outlined history. Also the simulator can take advantage of pre-run meetings of national decision makers as a unit, alliance partners, diplomats to international organization, etc., to develop background for the exercise itself. The impact of such activities must be measured. This can be done by noting variations in performance between no history/no meeting exercises and extensive pre-information exercises.

While the above review is far from exhaustive, the pattern has been established. Criticisms can be treated as guides to more intensive investigation. Rather than arguing about the impact of culture, for example, social scientists would be better served by experiments (simulation and others) which attempt to determine the exact manner in which this variable affects behavior. This type of knowledge can then be used to refine simulation models, making them more reliable research tools.

To return to our theme, we feel that conclusions that reject the use of simulation are premature as not nearly enough evidence in this regard has been collected and analyzed. On the other hand, as simulators, we feel the responsibility not to overextend the use of the technique until more is known about its operations. We are searching for the limitations of simulation. We are attempting to identify the problems amenable to analysis using the simulation technique and those cases in which it cannot be profitably applied. The "realm" of simulation may in the end prove smaller than we anticipate but we are willing to live with this, if critics are willing to live with the existence of a "realm".

IV

Revising Simulations

A number of research strategies are available for testing and revising simulation models.[15] The parameters and outputs of a simulation can be measured against similar real world data. For example the rate of economic growth of simulated nations could be compared to the development of real nations.[16] Hypotheses which have been tested in the referent system can be examined under simulated conditions. For example knowledge gained about behavior in crises can be compared to decisional outputs from simulated crises.[17] The extent to which exercises could replicate historical events given the same initial conditions provides some measure of simulations reliability.[18]

In this paper we will focus upon what we consider to be a most valuable yet underrated testing device - face validity. The simple subjective evaluation of simulation operations may appear unsystematic or "unscientific". Yet such a test has merit in the early stages of model building since much time and energy is saved. Often simulation results are blatantly non-isomorphic. The researcher need not look for independent data to demonstrate that his results are

unrealistic. He can make adjustments to his model until at the least outcomes on the subjective level no longer offend common sense.

The authors have been primarily engaged in this pursuit over the past three years. We suggest that this type of effort is often the most creative and productive for research. New ideas and insights are occasionally uncovered. More often simulation brings a fresh approach to old questions.

Efforts at the University of Alberta have largely been focused on a commercial simulation model called Inter-Nation Simulation (INS).[19] Simulation offers the advantage of concentrating on one subsystem of international politics while leaving the others constant. Our work has focused on the military subsystem, leaving the political, economic and social subsystems, unchanged until future systematic review of these areas is possible.

To those unfamiliar with a particular simulation model, a discussion of the INS often becomes very technical if not incomprehensible. To avoid this problem we will discuss our changes in general terms concentrating more on the "theorizing" that led to changes. This approach allows us to put forward a number of questions about international relations as well; questions we feel would not have occurred to us in quite the

manner they did had we not encountered them as a result of simulations run in 1967-68 and 1968-69.

We made two changes which had broad implications for the military subsystem (as well as the total model): the introduction of a Military Adviser and of geographic dimensions. These will be treated first. Other innovations were categorized under the functions carried out by the military. We discerned three prime functions: coercion, application of force and internal control. Our format is to discuss the weaknesses of the original INS formulation under each category, to provide some "theoretical" background to our changes, and to describe the innovations briefly. In each case our purpose is to illustrate the method of improving simulation models by observing its face validity.

Military Adviser - The simulator may devise as many roles as he deems necessary to accurately portray a national decision making organization. INS has five roles - a head of state, a domestic adviser, a foreign policy adviser, a diplomat and an official opposition leader. An obvious omission was the role and functions carried out by military establishments. Without such a specific assignment two broad effects were noted. Our early exercises revealed an almost complete lack of graduated policies between negotiations and declaration

of war. Participants tended to view international problem solving in black and white terms - either we sign a treaty or we fight to the death. There was either complete co-operation or total conflict; the nuances of the threat system concept were missing.

The second effect was the indiscriminate and unrewarding manner in which wars were fought. Attacks were total with the aim of destroying the target nation. Almost all nuclear and conventional weapons were unleashed against the enemy regardless of their capabilities. Thus small underdeveloped nations were attacked as ruthlessly as large nuclear powers.

When a military adviser was introduced, wars were launched with a far greater degree of "rationality" (if such a word can be applied). We found that players began to consider the consequences of military strategy and tactics. Expenditure of force was brought into line with the aims that were sought to be achieved. Wars were graduated, with rare use of nuclear weapons. Targets of attack were almost solely the other nation's armed forces rather than its economic and human resources. So as not to miss the point, however, the frequency of wars were much higher with a military adviser than without, but the greater number of wars were less devastating in effect.

Our innovation of a military adviser responsible for "national security" started us thinking again about that old problems of the influence of military establishments on national policy making. We noted how military advisers encroached on political and economic matters (e.g., attending alliance conferences, competing for economic resources to maintain armed forces, etc.) in confirmation of the many claims made about such real world practice.[20] It was interesting to note the number of successful negotiations concluded in the runs without military advisers; there seemed more pressure on participants to "talk out" their problems. The more frequent resort to the use of force with military advisers leads us to wonder about built in momentum to apply force if it is often used to threaten. The introduction of a military adviser had the adverse effect of increasing the tendency to depend on the threat of force to solve problems, but the opposite effect of the ability or good sense to stop fighting short of all out destructive attacks. In short there was much more pushing and shoving but no butchering.

Geographic Dimension - Professor Guetzkow, the formulator of INS, early noted the absence of geographic influences in INS.[21] One simple step we took to introduce the geographic dimension was to define the nations and history of our simulated world in

terms of a map. We noticed some immediate changes in operation.

First, we learned that we could impose a great deal more simulated historical background on participants. Our "world histories" jumped from 4 to 12 pages without the complaints there had been on previous attempts without a map.

Also as Kenneth Boulding observed:

> The schoolroom maps which divide the world into coloured shapes which are identified as nations have a profound effect on the national image.[22]

A map acts as a frame of reference for decision-makers. Interesting differences in behavior were noted between map and non-map exercises. In non-map exercises, message sending and alliance formation was carried out fairly randomly. In runs with a map, positive messages were directed to the "nearest" nation and alliances tended to be formed with nations bordering one another. Also, in one instance a nation was drawn up composed of two separated parts simulating Pakistan, or East Germany and The Federal Republic. In 13 of 14 runs the nations responded with consistent attempts to unite their lands at the expense of the intervening state.

Finally we clearly marked out the distribution of

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resources and people for each nation; these characteristics of other nations appeared on statistical sheets available to all players. In the play of the game we noted that options such as infiltration to cause civil unrest which were available against other nations were almost always directed toward marked resources and people. This leads us to wonder about the extent to which maps when used in real world policy making, tend to focus attention and affect decisions.

Application of Force - Our revisions in this area were made with the thought that the whole area encompassed by the term "application of force" is fraught with danger. On the one hand INS war procedure must be as realistic as possible and must include sufficient options and constraints to replicate wars as they have occurred in the real world. On the other hand there existed the undesired possibility of transforming INS into a war game, of introducing so many variables that attention would be focused upon conflict to the neglect of other international strategies. To find the middle ground we increased the number of considerations associated with going to war but transferred most of the arithmetic calculations from the participants to the directors.

The first specific defect we had to deal with was the

certainty of outcome which preceded entry into war. The destructive formulae of weapons are explicit in INS, thus participants could calculate the losses in war and decide before the fact whether victory was possible. This led to such non-isomorphic results as attacks on weaker nations primarily motivated by the knowledge of certain victory (and spoils). Uncertainty had to be introduced into INS war procedure.

The second major defect was the poor differentiation between nuclear and conventional weapons. In the original formulation we found nuclear arms simply provided more destructive weapons at less cost than conventional forces. Nations going to war applied their most efficient arsenal which promoted "surgical nuclear strikes" against an enemy's armed force; we noted that large nations captured weak nation's resources intact by quickly destroying the latter's smaller conventional field armies. Since the same strategic considerations determined the use of nuclear and conventional weapons (to the detriment of the latter since less was accomplished for the cost) we felt the two types of force required discrimination.

To overcome these problems we eliminated the explicit destruction formulae. Participants were informed in general

terms of the weapons capabilities - sufficient data was given to develop strategies but not enough to predetermine outcomes of battle. We also reasoned that a distinguishing feature of nuclear weapons were radiation aftereffects. Thus we developed a scale to represent fallout destruction. This scale featured a randomizing technique; not only were economic and human resources in the target nation reduced to varying degrees, but the resources of neighboring nations were affected as well. Although the exact affects of blast and radiation were known only to the directors, participants could gain more precise information by "detonating" experimental devices; these, naturally would increase radiation levels.

These changes to nuclear capabilities increased isomorphism. Participants were much more hesitant and concerned about the use of nuclear arms. Leaders of non-nuclear powers became much more involved in an arms race when they understood that their countries could be damaged even though they were not parties to a war. Test ban treaties took on greater relevance since too high a level of fallout caused damage.

Conventional war procedures were also altered. Our original attempts to increase uncertainty of battle outcomes

centered on the introduction of qualitative as well as quantitative differences among conventional forces. In the real world such variations in efficiency of equipment, training of troops, morale, efficiency of communications and competency of commanders play a large role in war. Consequently a force that appears numerically inferior to another could in fact be qualitatively superior - as was the case of the German army compared to the Russian forces in 1914-18. Therefore we weighted the destructive capabilities of each nation's conventional forces. If the two countries mentioned above were used as examples we could enhance the German capabilities by a factor of 1.5 while decreasing the Russian forces by a factor of .75. Thus while two numerically equal forces met, the German force would carry twice the advantage of the Russian. We found this method particularly useful in simulations relying upon historical precedent since adequate data was available to determine realistic weights of national forces.

However since information regarding present day forces is not readily available to the researcher we adopted a second more general technique to determine battle outcomes. We randomized battle results. The key principle involved is that equivalent forces have an equal chance of winning;

a larger force stands a better chance of victory, but within pre-established parameters a smaller force can possibly win. This method necessitated that both parties to war designates the size of force sent into battle. Thus, although, this requirement increased the amount of time and effort in conducting a war it accorded well with the second major modification to conventional forces.

We felt that an important distinguishing feature of regular forces was their capacity to occupy territory. Thus battles were associated with regions designated on a map. The nation-at-large is not attacked as is the case in the original INS formulation. Conventional wars are positional with forces striving for control over territory. Designed into the tables that determined battle results were indications of the size of force remaining after fighting. Participants could attack, withdraw, or reinforce areas.

The innovations as a whole separated nuclear and conventional strategies. They also managed to eliminate much of the cavalier behavior sometimes evident in original INS runs - going to war simply because the calculations predicted victory. The total effect was not so much to reduce the amount of time devoted to war considerations but to make this effort more fruitful and realistic. Instead of carrying

out numerous calculations based on known destruction equations, participants were concerned with deployment of forces, with troop movements to threaten or deter enemies and with defense of vital territory (containing important resources). The calculation of destruction were totally in the hands of the director.

The Coercive Function of the Military - As we have stated simulation often reveals a gratifying self-correcting aspect. If a particular variable or relationship is left out in an original formulation, the simulator often receives considerable feedback from participants about such omissions. Thus the model "grows" or becomes more sophisticated as both participants and directors add their ideas. One set of innovations stimulated by such feedback concerned coercive moves carried out by the military. These involved increasing the role of espionage and developing options for conventional forces beyond just attacking.

We felt that the espionage function in INS was extremely ineffectual. In INS, every fifth secret message is printed in the world newspaper to represent information leaks. This system is unsatisfactory because the espionage function was passive - unlike real leaders, national decision-makers in simulations had no control over intelligence

gathering. Also publication of secrets compromised the utility of knowing about such secrets; hidden plans revealed in the newspaper for all to read were simply abandoned. Modifications were introduced to allow decision-makers to invest their resources in the gathering of intelligence; return of information varied according to the amount of the investment.

The espionage innovations produced immediate results. One obvious output was the introduction of another tension issue between nations. Our simulation model could finally replicate such incidents as the U-2 and Pueblo cases.

A more meaningful result was observed when the degree of information was manipulated. If intelligence about other nations could be envisioned on a spectrum from little to very much we noted a distinct lack of interaction occurring at either end of the spectrum. Leaders were reluctant to make decisions based on very little knowledge or became paralyzed searching for the "right" decision under conditions of abundant knowledge of the enemy. The reasons for such hearty behavior in the middle ranges of knowledge would have interesting and perhaps illuminating impact for real world research.

The second important area in which many successful innovations were introduced concerned using forces to gain

an advantage short of going to war. We concentrated on improving the ability of nations to move forces into close proximity of potential targets, to mobilize extra forces and to improvise blocades.

Combined with our introduction of a military adviser these innovations produced a much improved model, capable of replicating complex international behavior. Participants developed intricate international strategies. They paid more attention to their own national decision-making process to insure that all the options available to them were reviewed. Maneuvering to gain advantage was quite intense as players became concerned about the message conveyed by particular troop movements. The language and resolutions of international organizations were more realistic as specific threats and moves were discussed; in previous runs the best that could be achieved in such organizations were far less specific items such as non-aggression pacts. With the innovations, participants showed more sensitivity to the dictates of international law. In short we observed a greatly increased sophistication in "international" behavior in the game itself. Beyond the game we found students learned a great deal more about the complexities of the real world of international politics.

The impressive differences between simulations with few military options and our new model reinforced in our minds questions about the role of conventional forces in a nuclear era. The theme of the writings on this subject stresses that conventional forces have not become obsolete with the advent of nuclear arms.[23] On the other hand many argue that conventional forces are clearly secondary; that all strategic uses of conventional forces are highly mitigated by the threat of nuclear war. Our experience leads us to wonder whether stalemated nuclear forces have affected the primacy of conventional forces at all? We have concluded that major international events still turn upon the ability to apply conventional forces. The horrifying spectre of nuclear holocaust has not seriously disrupted or changed patterns of interactions.

Whether the case has been overstated or not, for the purposes of research we deem it absolutely necessary for simulation models to contain mechanisms whereby conventional forces can be built up, mobilized and moved in coercive manners. Not only is international behavior in simulations greatly improved, but many questions concerning threat patterns, escalation and perceptions are opened to more intensive and rigorous investigation.

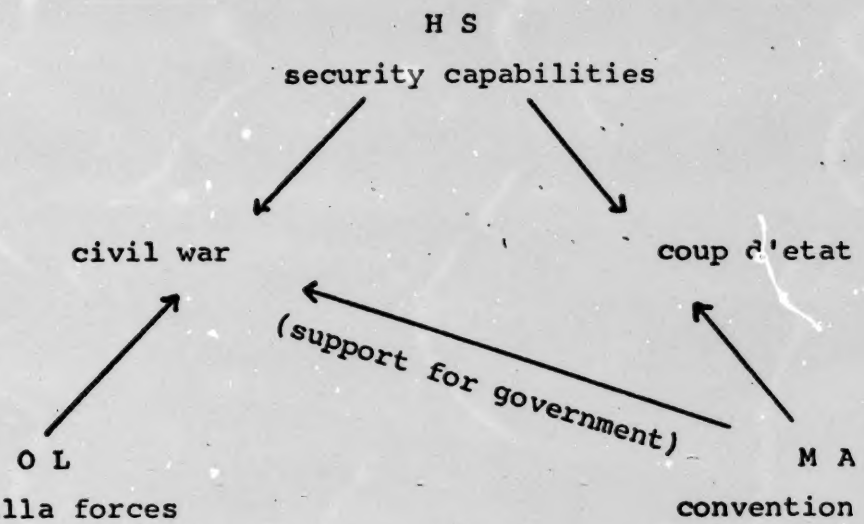
Internal Control - Much of our attention was devoted to the extensive revision of the revolution procedure in the INS. In its original formulation changes of office in INS through illegal means were calculated by the directors during breaks between periods. Although this was consistent with the INS principle that all domestic processes are programmed (i.e., outputs are calculated according to predetermined formulae) we felt that revolutions impinge so much on international behavior that they should be treated separately. As K.J. Holsti observed:

> In some 200 revolutions which occurred during the first half of the (twentieth) century, foreign intervention took place in almost one half; in approximately 40 of these revolutions, more than one outside power intervened. . . . Most international crises of the period have started basically as internal revolution or civil disturbances, in which one or more external states eventually became involved.[24]

The cost of a more complex revolution procedure seemed well worth the price, in that it allows us to effectively investigate cases of intervention.

The thrust of our innovations was to create roles and capabilities within nations which could be used to seize or protect the office of head of state. In reducing this process to its elements we discriminated between the quick coup d'etat style of capturing office and large scale civil war. Noting that military leaders most often employ coup d'etat we gave

the official military adviser the capacity to carry them out. The civilian opposition leader was allowed the capability to conduct revolutions. To this end he could develop guerilla forces. The third party in such internal disturbances, the head of state, could develop "security capabilities" to represent the portions of the army loyal to him, private armies, control of strategic centres and so forth. Diagramatically the options and type of forces involved in illegal changes of office are represented in figure I.



An opposition leader or military advisor aspiring to become head of state could be supported by external powers. Either moral support or military hardware could be given. The need for introducing this capability is painfully obvious in contemporary international relations.

Although the four exercises conducted to investigate the feasibility of the scheme were too few to reach any final conclusions, some observations can be reported as preliminary evidence reinforcing the utility of the new procedure. First the scheme is practical. Our fears of massive outbreaks of revolution were not born out. Of a total of 28 nations involved, civil disorders occurred in 5 with more than one disturbance occurring in some nations. In each of the five cases revolutions occurred in nations with characteristics, i.e., form of government, economic conditions, popular discontent, and geographic positions, which had a high degree of "goodness of fit" with real world phenomena.

The second point is that Holsti's observations were generally replicated. There were 10 episodes of illegal attempts at seizure of office; four remained purely indigenous; the rest involved some degree of foreign interference with two escalating to international crises.

In trying to isolate the source of interference by role we discovered interesting links. Heads of states were most sympathetic with the plight of their counterparts in nations faced with insurrection. On the other hand, support for civilian guerrilla leaders came primarily from the Foreign Policy Advisers of other states. The highest degree

of cohesion was exhibited among the Military Advisers. They displayed a tight knit professional sharing of interests and most often came to each others support. Any generalization about this patterning is at present very risky. Nevertheless thinking about these results leads to interesting questions. What are the characteristics of penetrated systems? What is the effect of horizontal ties between groups? What is the effect of communication and/or interference across national boundaries?

One final point remains to be made about our revolution procedure. We recognize that in its present form, the format is not sophisticated enough to deeply investigate the questions mentioned above. Our intention was not to analyze revolutions. Instead we hoped to develop a procedure which would generate realistic inputs into the international system. While many domestic variables were omitted we are generally satisfied that the new procedure is an improvement on the old formulation. Participants had to account for the phenomena of intervention, a variable missing in the original INS. This final observation is not to disclaim that simulation models cannot fruitfully investigate the phenomena of revolutions; it is simply to make clear that our particular model was not designed to address this question. But herein

lies the advantage of the simulation technique. A model can be created to focus on almost any social experience and revolution processes are certainly a fit concentration.

V

Simulation Research Strategy

To this point we have addressed two of the major reasons why simulation is not used with greater frequency, that is, lack of familiarity with the device and hesitance generated by the criticism surrounding the device. Now we will set out a short outline of how we approached some of the problems involved in conducting a simulation. We feel it quite possible that uncertainty in this area has also influenced some not to use simulation. The outline is not exhaustive but may serve to set some thinking as to how they might use simulation in teaching and research. Examples cited in the following discussion were generated by our experience at the University of Alberta in three research projects carried out from 1968 through the current year. In them we used students from Edmonton High Schools, and from the Political Science Department's introductory politics and international politics courses.

Determine the Problem and Questions - Our interests focused

on the factors which would upset the stability of a world, locked in a "balance of terror". We felt at least two in particular could influence international stability: a technological breakthrough by one of two superpowers and the rise to superpower status of a third power. The debates on an ABM system for the USA led us to imagine a technological invention that would radically increase a nation's capacity to defend itself against nuclear attack. We wondered what the consequences would be if one of the superpowers could become virtually invulnerable. We then speculated on the impact on world events of a third power developing such a defense capacity? Would its goals be increased? If so, what would be the reaction of the two superpowers? The wide variation of possible answers to these questions is tantalizing. While we had hoped to present detailed information as to the results of our runs it is not possible to do so as we are still in the process of analyzing the data we collected in over 28 runs.

Choose the Simulation Model - There are a number of commercial models and programs for computer models available. The simulator chooses the model which includes most of the variables he is interested in. Often he will find that modifications to a model are necessary. We settled on Inter-Nation

Simulation (INS) having incorporated the revisions discussed earlier in this paper.

Develop the World Situation - The initial parameters of the simulated world are created to reflect the problem. Some of the specific considerations are:

a) the number of nations: The simulator can develop prototypic nations; countries that could represent a number of counterparts in the real world. For example one nation could be developed to represent a number of developing African nations. We created seven prototypic states.

b) the distribution of power and resources: Economic and military capabilities are determined. We established two nuclear superpowers; two middle powers with limited nuclear capacity and three underdeveloped nations.

c) political, military and economic linkages: Alliances, trade patterns, message flows, recognition or non-recognition of states, membership in international and regional organizations, etc., are determined.

d) history: Sequence of events up to the time of the exercise are written. Our practise is to outline major events for the "previous fifteen years."

e) scenarios: Since all nations receive the common history, each may be given a confidential report on its own background for the preceeding years. The scenarios include special information not available to others and information on particular viewpoints adopted in the previous 15 years.

Establish Hypotheses - Once the "world" is set, specific "if . . . then" statements can be made. We decided to introduce a technological breakthrough at the end of the first

"year" of operation (as a result of research and development investments). We could thus make predictions about changes in international behavior and attitudes as a consequence of this experimental interference.

Determine the Method of Data Retrieval - Once the problem and hypotheses are developed, the type of data required can be decided. In many cases, the normal amount of paper-work associated with the simulation (e.g., decision forms, messages) will provide adequate information. However special questionnaires or tape recordings of negotiations may be required.

Assign Participants - Two methods are available in choosing participants:

a) If a large reserve of players is available then personality and attitudes tests may be administered. Particular profiles may then be adopted.

b) If a limited number of players are available then a random assignment to roles should reduce idio-syncratic influences.

Organization - Numerous practical functions must be prepared. Among these are:

a) physical layout - The laboratory should include adequate office space or compartments for each nation, administration, and negotiations.

b) equipment - Adequate chairs, tables, calculating machines, etc. must be planned. A checklist of such items is handy. (Don't forget the coffee pot!)

c) forms - Any forms required by the model (e.g., treaty forms, message forms) should be available in sufficient number.

Control Team - The number of people and distinct duties should be clearly predetermined. For our purposes we used a Director, a data collector, two advisers (to explain mechanics not policy), two newspapermen, and three couriers.

Conduct the Exercises - If the preparations are carefully planned and executed, the actual exercises run very smoothly and are quite enjoyable. The simulators greatest concern is to promote the same external influences on each run and to avoid inputs that jeopardize results.

Analysis of Data - According to the method adopted (e.g., content analysis, statistical operations, etc.) the hypotheses can be tested.

VI

Summary

Our concern has been that simulation is an underused technique. Three reasons for this we felt were a general lack of familiarity with the techniques advantages; the effect of criticisms of the method; and uncertainty about what is involved in a simulation research project. To encourage broader employment of simulation we addressed each

issue.

The advantages of simulation were outlined. Overall the most positive feature it offers is the ability it gives the researcher to control and manipulate experiment variables. This opportunity is not readily available when conducting real world research.

Our major theme with regard to criticisms leveled at simulation is that they do not constitute evidence that the technique should be abandoned. They are useful in focusing on weaknesses of simulation in its present stage of development. We have granted that simulation models must be revised and more rigorously tested before they become useful for research, but until this testing is done, it is premature to reject the technique.

By way of example we have demonstrated how a simulation model can be improved. Using face validity evaluation we pointed out the faults of a particular simulation model and suggested innovations to correct these weaknesses.

Finally we set out the steps we consider necessary in conducting a research project. While these followed general patterns of experimental research, we included some of the peculiar, practical considerations associated with simulation.

As initially stated our aim was to promote the use of simulation. We hope this paper has shed light on the issue and will direct increased attention to a new technique which we believe will significantly advance our understanding of international politics.

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Footnotes

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